Global Lightning Climatology from TRMM LIS and OTD

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- **LIS/OTD Science Teams, support from NASA TRMM**
- **GHRC- hosting the LIS data**

Documentation of Dataset

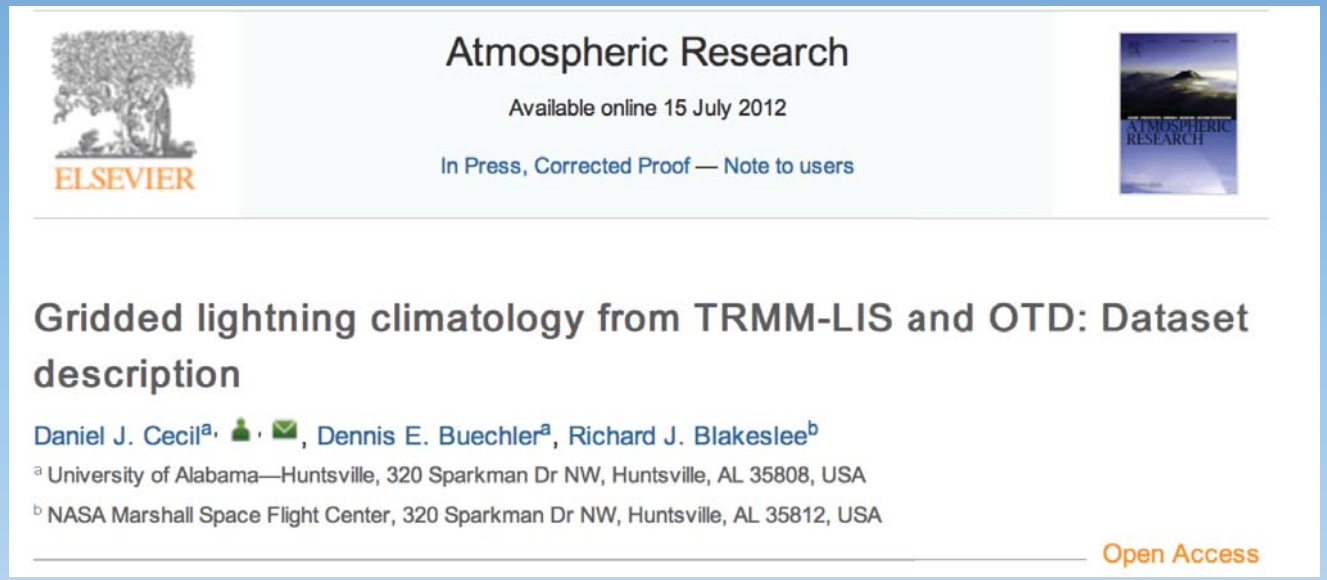
http://dx.doi.org/10.1016/j.atmosres.2012.06.028

Description of all gridded LIS-OTD climatology products in Cecil et al (2014) Atmospheric Research

Dataset subsequently updated through 2013

Detection efficiency as a function of diurnal cycle is accounted for

Variable sampling duration as a function of latitude is accounted for



ELSEVIER

Atmospheric Research

Available online 15 July 2012

In Press, Corrected Proof — Note to users

Gridded lightning climatology from TRMM-LIS and OTD: Dataset description

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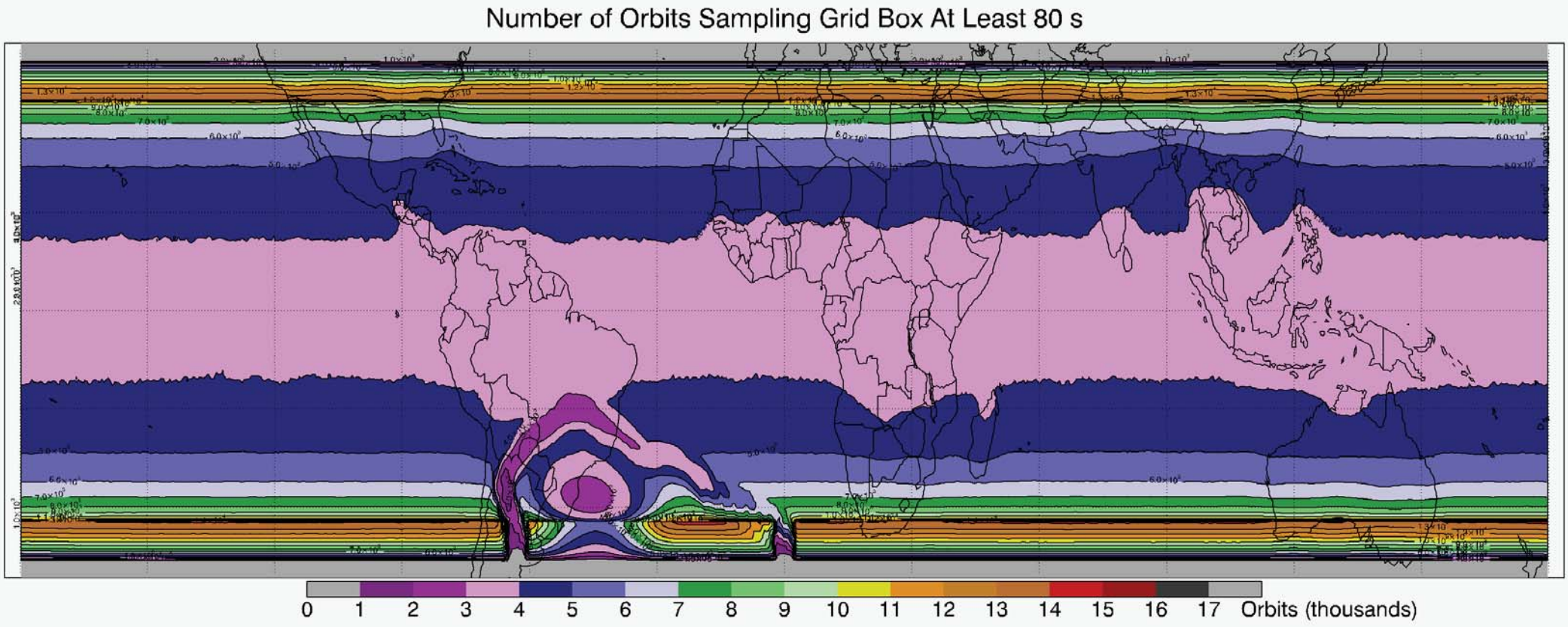
Open Access

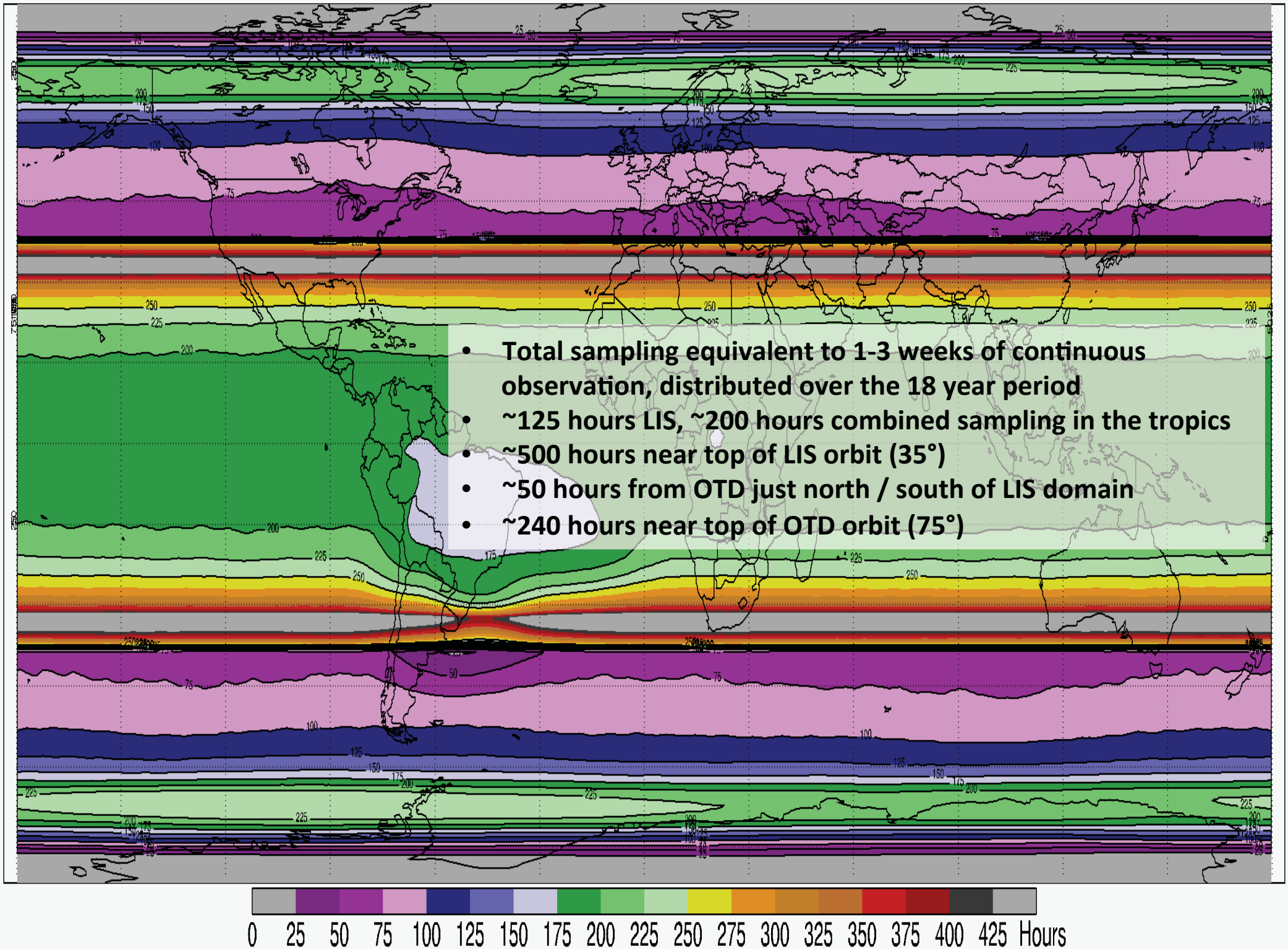
Animations of Mean Flash Rate over annual cycle and diurnal cycle shown in that paper, with updates at:

http://lightning.nsstc.nasa.gov/data/data_lis-otd-climatology.html

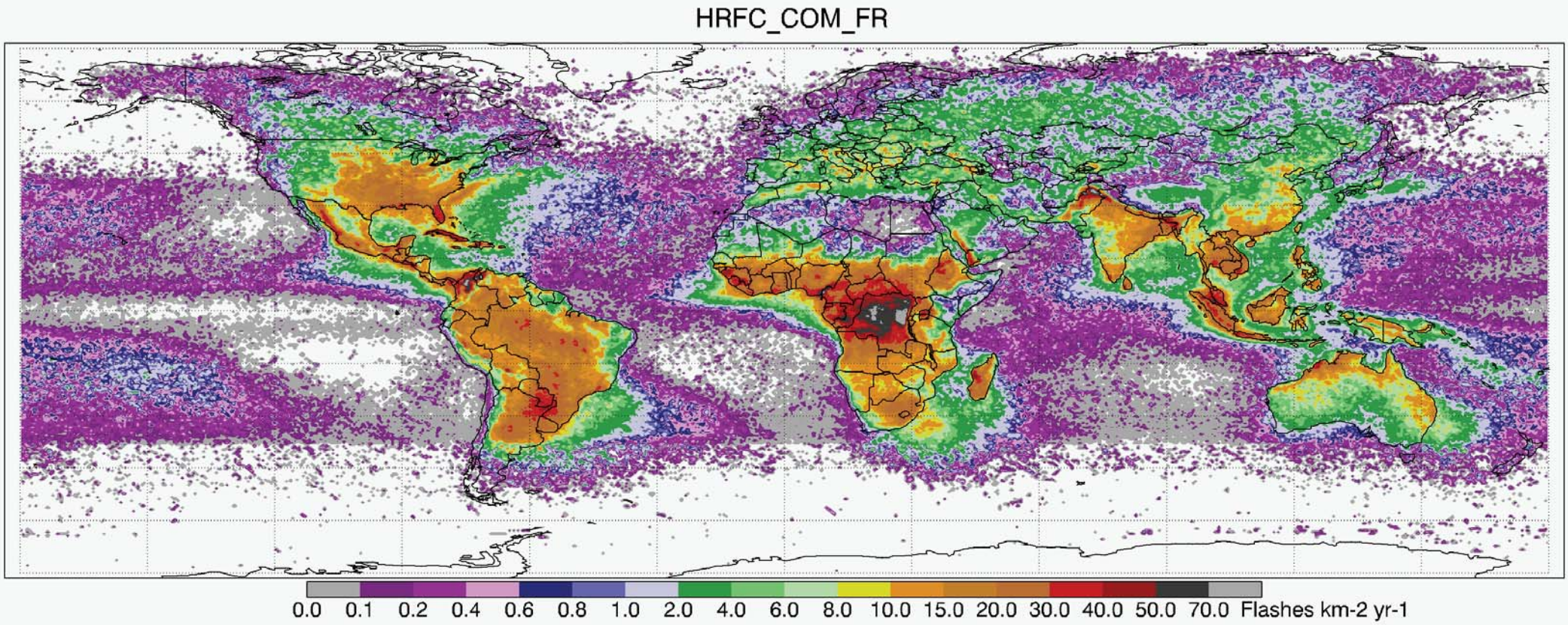
Sample Size – LIS 1998-2013



- **All locations in Deep Tropics have been sampled by 3000-4000 orbits, typically around 90 seconds each orbit**
- **~6000 orbits have sampled locations at +/-26° (e.g., Tampa)**
- **~13000 orbits have sampled locations at +/- 33° (Phoenix, Dallas, Atlanta), with rapid decrease beyond that**
- **South Atlantic Anomaly prevents complete sampling in Southern Brazil, Paraguay, Uruguay, Argentina. Many orbits there have only partial sampling (< 80 s)**


• Total sampling equivalent to 1-3 weeks of continuous observation, distributed over the 18 year period
• ~125 hours LIS, ~200 hours combined sampling in the tropics
• ~500 hours near top of LIS orbit (35°)
• ~50 hours from OTD just north / south of LIS domain
• ~240 hours near top of OTD orbit (75°)
0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400 425 Hours

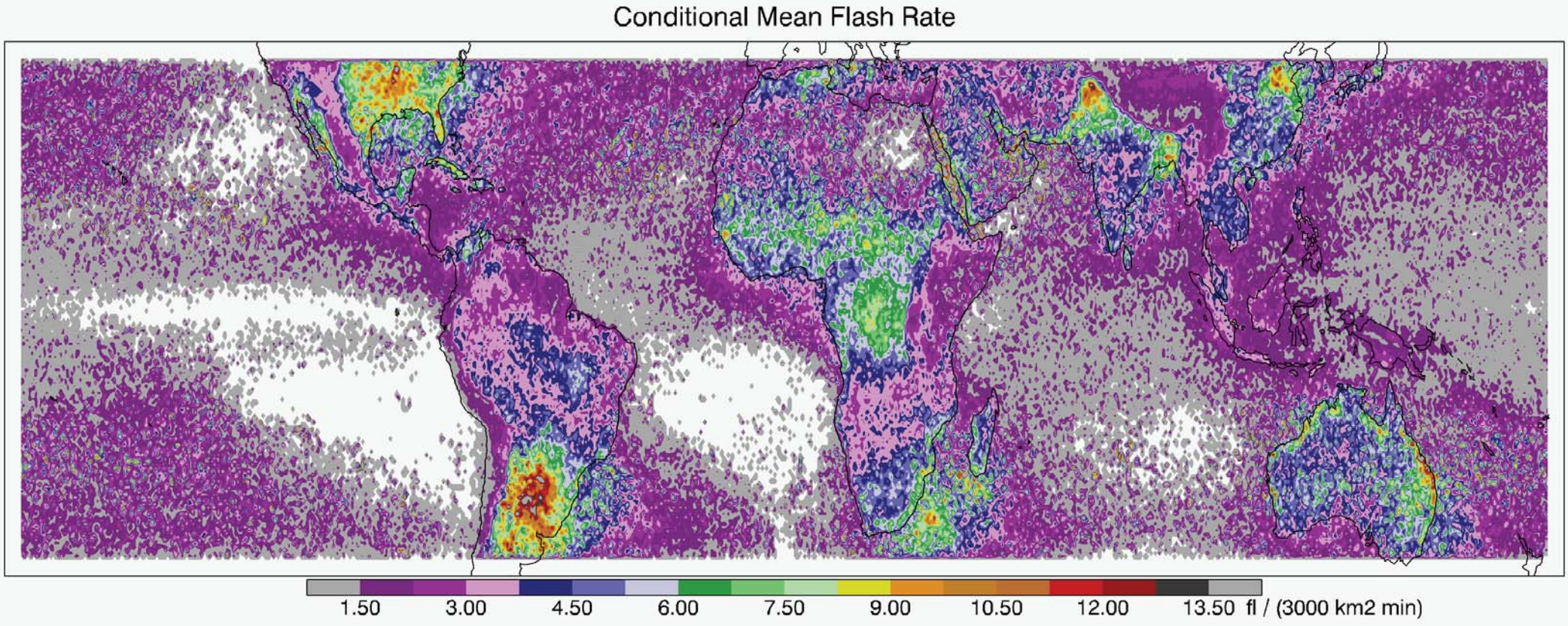
Mean Annual Flash Rate



Combined OTD (1995-2000, with high latitudes) and LIS (1998-2013, +/-38°)

- Peak: ~160 fl km^{-2} yr^{-1} in eastern Congo
- Higher resolution study (Albrecht) shows peak near Lake Maracaibo, Venezuela
- Other peaks in Maritime Continent, Bangladesh / East India, Pakistan, N. Argentina / Paraguay, west coasts of Mexico and Arabia
- Huge land-ocean contrast

Conditional Mean Flash Rate



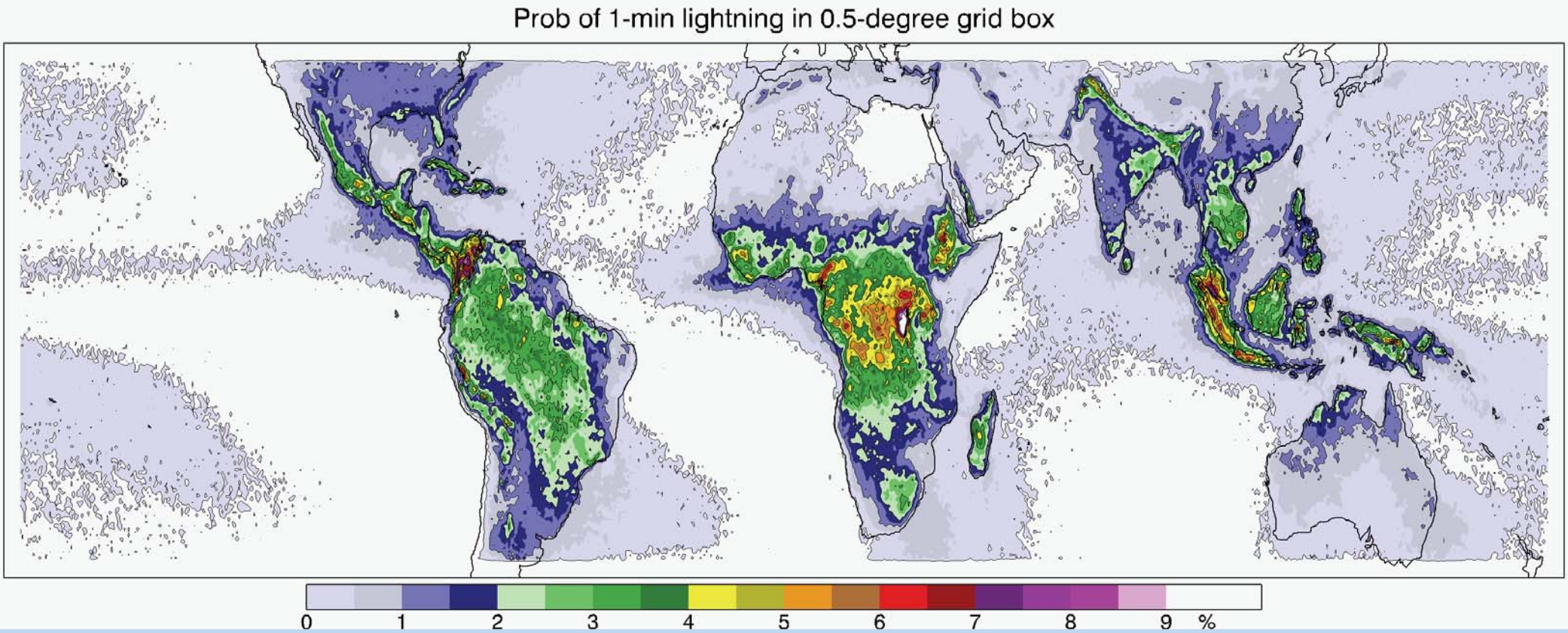
Annual Flash Rate depends on:

(a) How often thunderstorms occur, and

(b) How active those thunderstorms are

- Central Africa has sharp East-West gradient between frequent low-flash-rate storms (east), and less frequent higher-flash-rate storms (west)
- Highest flash rates in Argentina (> 10 flashes per minute mean, on 0.5° grid)
- East of Rockies, southern US has 6-10 flash per minute mean
- Subtropical hotspots have greater flash rates than tropical hotspots

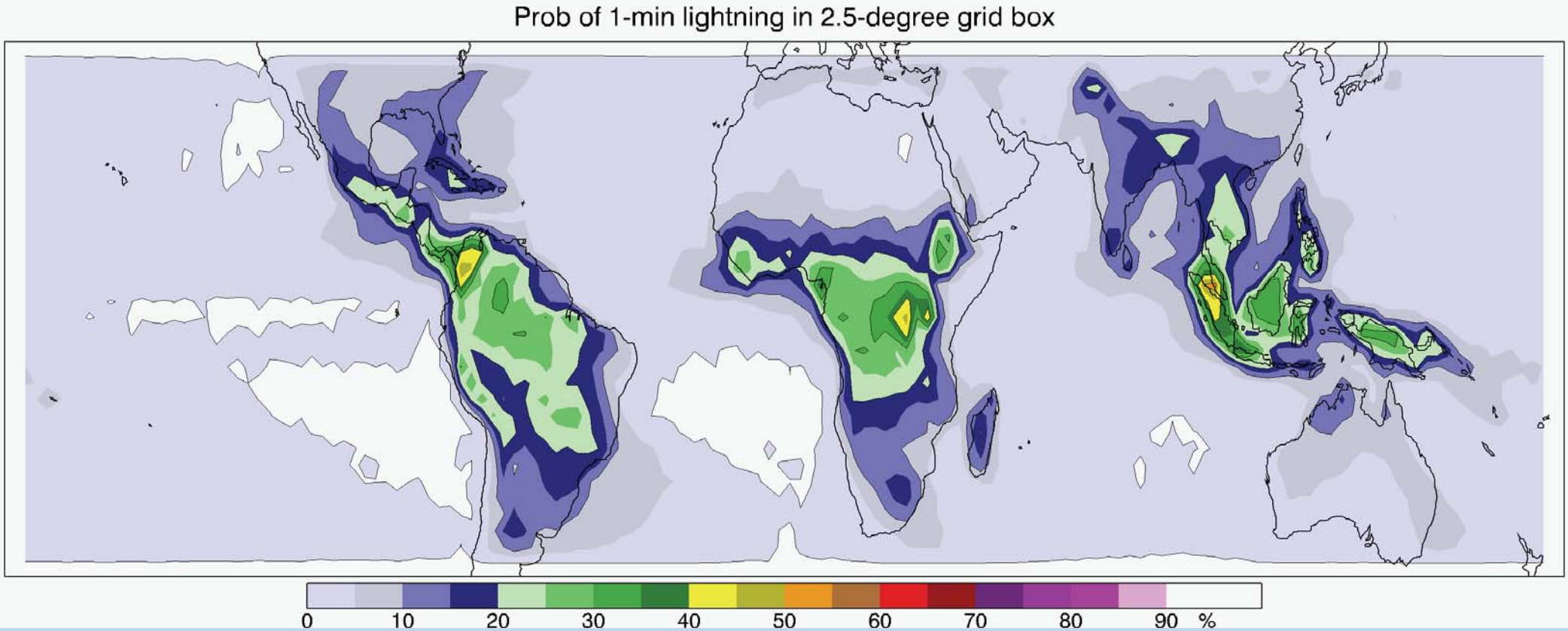
Fraction of LIS Orbits w/ Lightning in 0.5° Box



What is the chance there is any lightning within a ~50x50 km box, over ~90 seconds?

- Peak: Lightning occurs somewhere in a 0.5° box for about 13% of all ~90 s periods, in eastern Congo
- Highest lightning probabilities mostly associated with terrain features
- Most of US has lightning within a 0.5° box 1-2% of the time (for 90 s periods)
- Huge land-ocean contrast

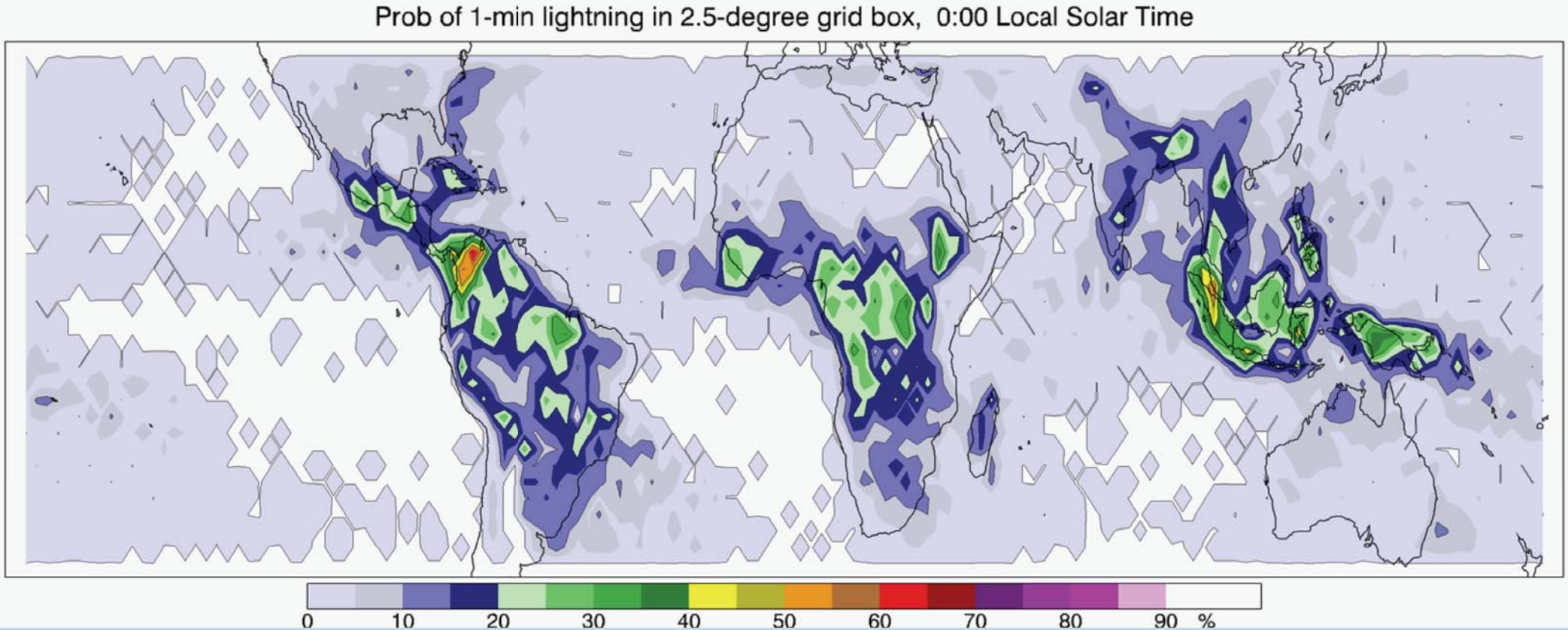
Fraction of LIS Orbits w/ Lightning in 2.5° Box



What is the chance there is lightning within a ~250x250 km box, over ~90 seconds?

- Peak: Lightning occurs somewhere in a *2.5° box* for > 40% of all ~90 s periods, in eastern Congo, Colombia, Sumatra
- Most tropical land locations have lightning within 2.5° box > 20% of the time

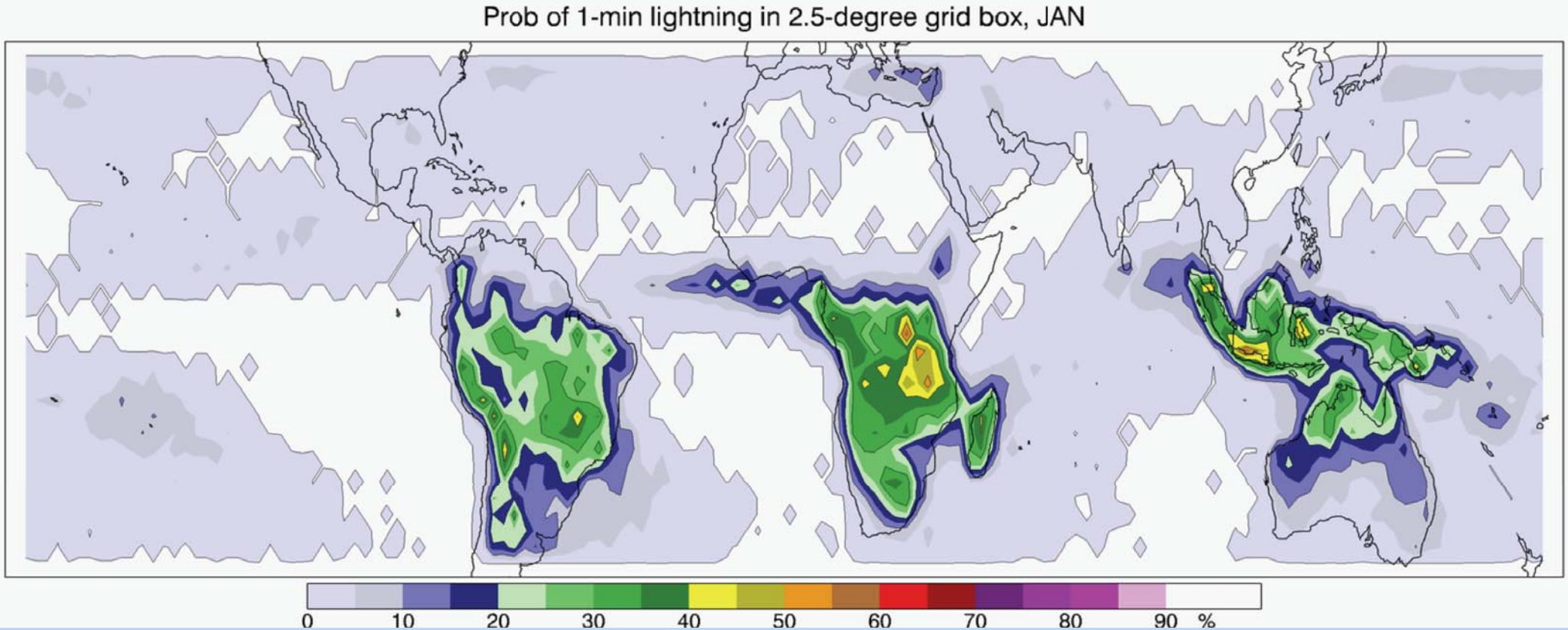
Diurnal Cycle of Lightning Probability in 2.5° Box



What is the chance there is lightning within a ~250x250 km box, over ~90 seconds?

- During afternoon, > 90% of orbits have lightning in eastern Congo
- > 20% for parts of SE US and southern Rockies
- Offshore max near 6 AM, onshore max in mid-afternoon for coastal areas

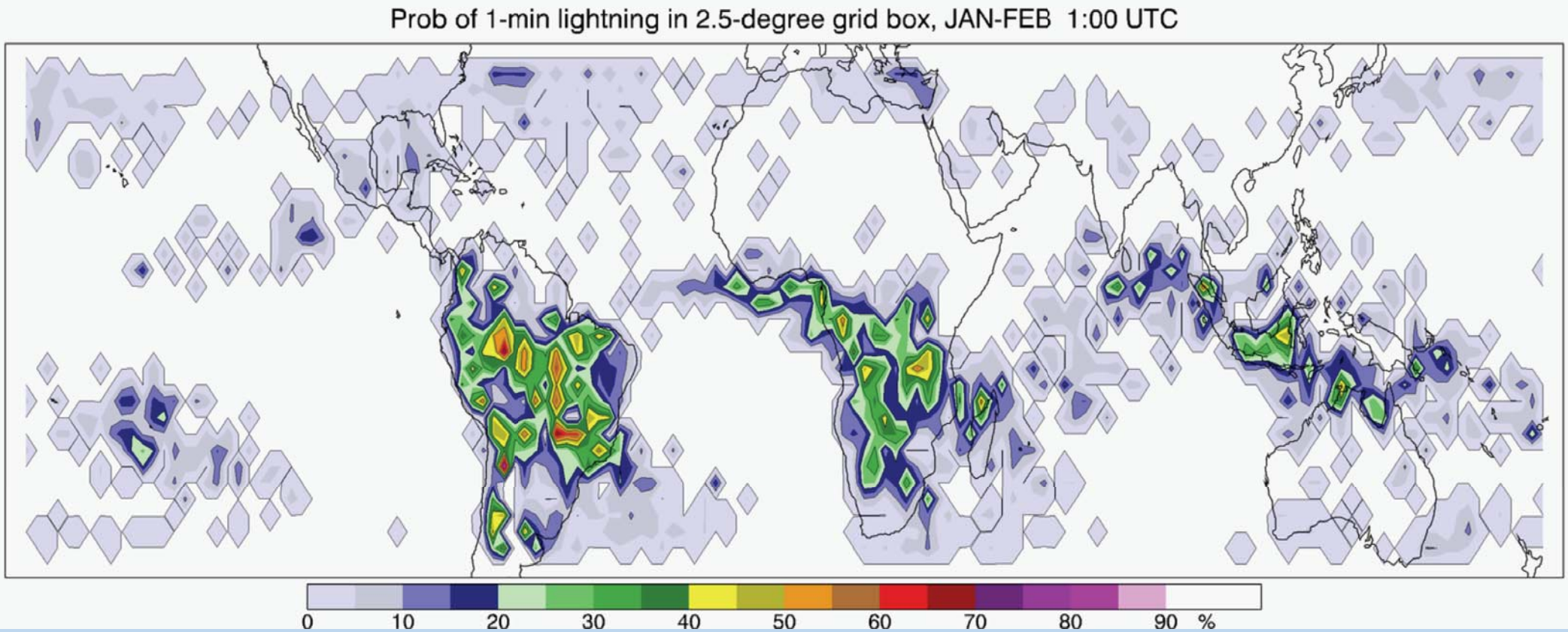
Annual Cycle of Lightning Probability in 2.5° Box



What is the chance there is lightning within a ~250x250 km box, over ~90 seconds?

- Seasonality as expected, with peaks generally in summer
- Want to combine this with diurnal cycle (next slide), but limited sampling makes it noisy

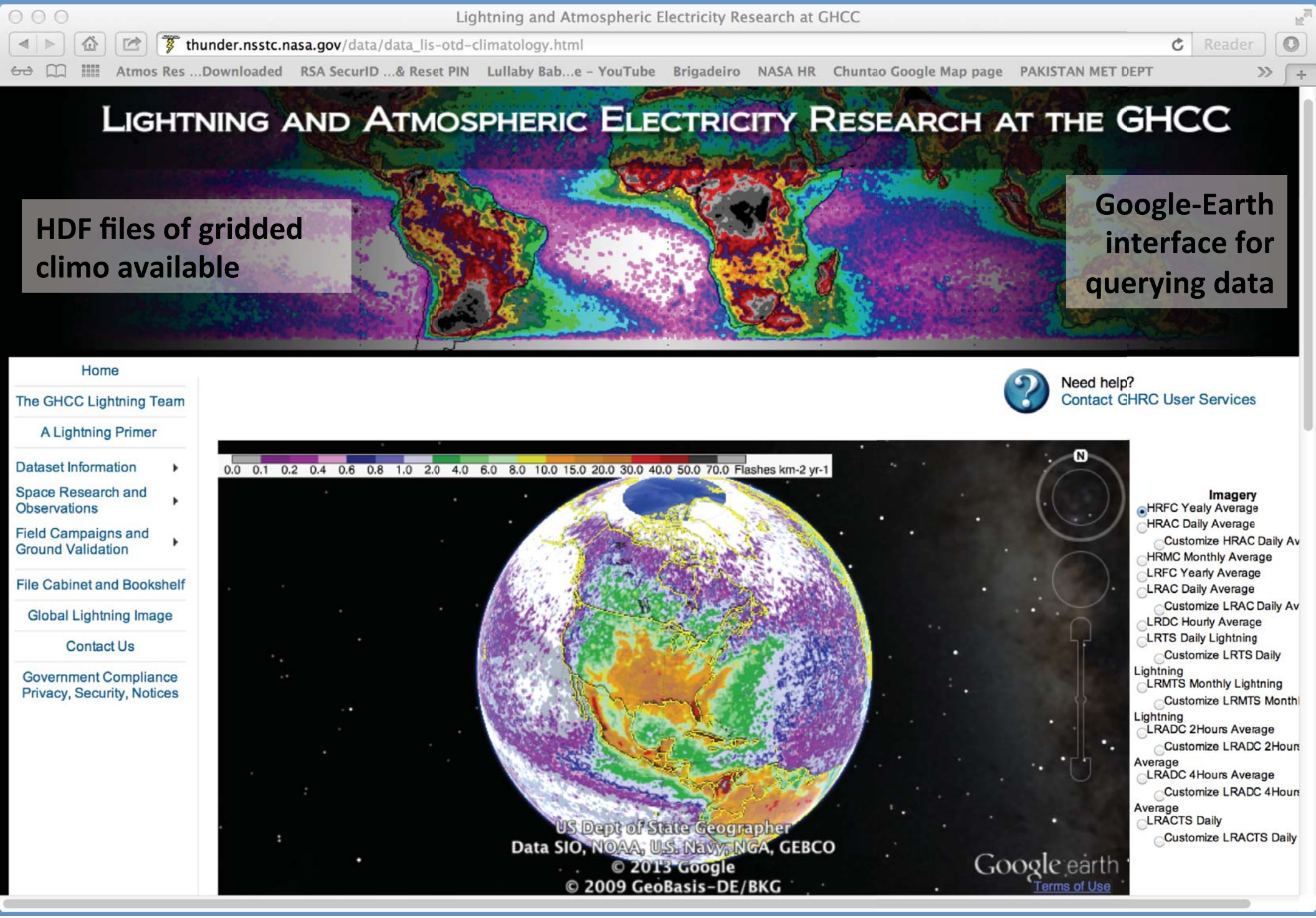
Annual Diurnal Cycle of Lightning Probability, 2.5° Box



What is the chance there is lightning within a ~250x250 km box, over ~90 seconds?

- Times are in UTC, for my convenience using previous software
- Don't focus on noisy details, the sampling is not robust
- Work in progress (very, very early!)

Lightning.nsstc.nasa.gov/data/data_lis-otd-climatology.html



Summary and Notes

- **LIS/OTD gridded total lightning climatology products (*mean flash rates*) have been updated through 2013**
- **Various products are available**
  - **Hi (0.5°) and Low (2.5°) resolution**
  - **Monthly, Annual, Daily, Diurnal**

- **Most of what was shown here (fraction of orbits with lightning; conditional mean flash rates) is not included in the current climatology products**

- **This was proof-of-concept, for consideration in future releases**

- **Feedback wanted – should these be included in the standard LISOTD climo files, included as separate files, or not at all?**
- **Annual Diurnal Cycle product is in UTC, not LST – would switching that introduce a problem for users?**